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# Estimating the time varying NAIRU in Iran

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# Estimating the time varying NAIRU in Iran

## Abstract

**Purpose** - The main purpose of this paper is to provide more accurate estimates of Iran's time varying non-accelerating inflation rate of unemployment (NAIRU) than what already exists in the literature.

**Design/methodology/approach** - Using the Kalman filter approach and annual time series data spanning from 1959 to 2008, the paper presents two estimates of the NAIRU for Iran.

**Findings** - The estimated two measures appear to be robust and consistent in terms of their magnitude and pattern, having a more logical upper limit of 11.1 per cent. Irrespective of which of the two models are considered, the results clearly indicate that overall Iran's NAIRU has been on the rise since the 1960s and whenever the unemployment rate lies below the NAIRU, the rate of inflation has exhibited an explosive behaviour. Such a phenomenon was observed in both 1995-1996 and the post 2006 era.

**Originality/value** - In the context of Iran, all previous studies have consistently over-estimated the maximum value of the time varying NAIRU. In these studies, the NAIRU's upper limit ranges from 14 to 20.7 per cent. The paper concludes that such implausible high rates are as a result of the overestimation associated with misspecification errors in their model.

## Keywords

varying, nairu, iran, estimating, time

## Disciplines

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# **Estimating the time varying NAIRU in Iran**

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# **Estimating the time varying NAIRU in Iran**

## **Abstract**

The main objective of this paper is to provide more accurate estimates of Iran's time varying Non-Accelerating Inflation Rate of Unemployment (NAIRU) than what already exists in the literature. Using the Kalman filter approach and annual time series data spanning from 1959 to 2008, we present two estimates of the NAIRU for Iran. Our estimated two measures appear to be robust and consistent in terms of their magnitude and pattern, having a more logical upper limit of 11.1 per cent. Irrespective of which of the two models are considered, our results clearly indicate that (a) overall Iran's NAIRU has been on the rise since the 1960s; (b) whenever the unemployment rate lies below the NAIRU, the rate of inflation has exhibited an explosive behaviour. Such a phenomenon was observed in both 1995-1996 and the post 2006 era. In the context of Iran all previous studies have consistently over-estimated the maximum value of the time varying NAIRU. In these studies the NAIRU's upper limit ranges from 14 per cent to 20.7 per cent. In this paper we conclude that such implausible high rates are as a result of the overestimation associated with misspecification errors in their model.

**Keywords** Iran, NAIRU, Unemployment, Kalman Filter models

**Paper type** Research paper

## **1. Introduction**

According to the Central Bank (2011), Iran's total population was 77 million in 2011. Political and religious leaders zealously supported a totally inappropriate policy of population growth after the 1979 revolution, particularly in the 1980s. This population policy was abandoned during the last two decades but the population continues to grow due to its momentum and dynamic nature as exhibited by four of Iran's population pyramids in Figure 1. Population growth decelerated from 3.9 per cent in 1986 to 1.5 per cent in 2011. A cursory look at Figure 1 clearly

indicates that approximately 26 million (or 33 per cent of total population) in 2010 were between 15 and 30 years of age. For this reason the population pyramid in Iran is literally referred to as a “time bomb”. According to Valadkhani (2003) every year around 800,000 new job seekers enter the labour market but the economy has not been able to create more than one-third of this figure. He argues that if the economy continues similar to its past performance, approximately half a million people could be added to the total unemployed population every year.

**[Figure 1 about here]**

Salehi-Esfahani and Shajari (2010) uses a large sample derived from Iran’s 2006 census and the Probit and multinomial Logit models and attributes the rise in Iran’s unemployment rate to a significant increase in women’s education and participation in the labour force. He also argues that the youth unemployment is at record high levels and it appears that more education does not necessarily make them more employable. Based on recent survey data for the period 2007-2008, Salehi-Esfahani and Shajari (2010) explains that Iranian female baby boomers have reached the adulthood age several years earlier than their male counterparts from the same cohorts. This creates a problem referred to as “marriage squeeze” (Salehi-Esfahani and Shajari, 2010).

The objective of this paper is to provide an accurate measure of the NAIRU for the Iranian economy. It is important to know the time-varying NAIRU ( $U^*$ ) because pursuing expansionary or contractionary monetary or fiscal policies to a large extent is dependent upon whether the actual unemployment rate ( $U$ ) is below or above  $U^*$ . Huh (2006, p.177) describes the NAIRU “as the unemployment rate which would correspond to a forecast of no inflation change over the policy horizon.” One then expects an expansionary monetary and fiscal policies when  $U > U^*$  and vice versa. There is convincing evidence in the literature that the NAIRU should be considered as a useful policy tool for forecasting future changes in inflation (see for example Huh, 2006; Stanley, 2002).

There has been a growing interest in estimating the NAIRU for the Iranian economy. Table I summarises some of these studies which differ in sample frequency, size and econometric methodology. While the minimum value of the NAIRU varies from 2 per cent (Golmoradi and Dezhpasand, 2011) to 7 per cent (Barkchian and Sarem, 2011), its upper limit has showed equally a wide range varying from 14 per cent (Barkchian and Sarem, 2011) to 20.6 per cent (Mottaghi, 1998). The NAIRU depends on the degree of supply side unemployment and no one knows exactly what its value is. However, previous NAIRU estimates appear to be excessively high as they have never been estimated below 14 per cent. It is difficult to attribute 14-21 per cent unemployment to frictional, structural, and classical unemployment. This paper examines the possibility that such an overestimation could be resulting from specification errors.

**[Table I about here]**

The structure of this paper is as follows. In Section 2 our theoretical framework is postulated which specifies two alternative dynamic models in estimating the time varying NAIRU using the Kalman filter approach. The empirical econometric results as well as policy implications of the study are presented in Section 3. Some concluding remarks will follow in Section 4.

## **2. Theoretical framework**

All previous studies stated in Table I have consistently over-estimated the maximum value of the time varying NAIRU. In these studies the NAIRU's upper limit ranges from 14 per cent to 20.7 per cent. It can be argued such an overestimation may reflect the misspecification errors associated with the absence of import prices in the Phillips equation. Import prices represent the cost of imported goods that are either consumed or enter the production chain as intermediate and capital goods and as such they should appear in the Phillips equation (Gruen *et al.*, 1999). Therefore, following Staiger *et al.* (1997), Gruen *et al.* (1999), Katsouli and

Pallis (2003), *inter alia*, we propose the following two augmented Phillips curves to estimate the unobserved time variant NAIRU series over the sample period:

Model I:

$$\begin{cases} \Delta \ln(P_t) = \gamma_1 (U_{t-1} - U_{1t-1}^*) + \beta_1 \Delta \ln(PM_t) + \alpha_1 \Delta \ln(P_{t-1}) + \varepsilon_{1t} \\ U_{1t}^* = U_{1t-1}^* + w_{1t} \end{cases} \quad (1)$$

Model II:

$$\begin{cases} \Delta \ln(P_t) = \gamma_2 (U_{t-1} - U_{2t-1}^*) + \beta_2 \Delta \ln(PM_t) + \varphi (Y_{t-1} - Y_{t-1}^*) + \alpha_2 \Delta \ln(P_{t-1}) + \varepsilon_{2t} \\ U_{2t}^* = U_{2t-1}^* + w_{2t} \end{cases} \quad (2)$$

Where:

$P$  denotes the consumer price index (CPI=100 in 1997),

$PM$  is the aggregate import price index (PM=100 in 1997)<sup>1</sup>,

$U$  is the actual rate of unemployment (per cent),

$U^*$  is the unobserved NAIRU to be determined by a recursive state equation in each model,

$Y$  is the log of actual real GDP,

$Y^*$  is the log of potential real GDP computed by the Hodrik–Prescott filtering approach,  $w_{1t}$ ,

$w_{2t}$ ,  $\varepsilon_{1t}$  and  $\varepsilon_{2t}$  are white noise residuals.

In these two equations  $\gamma_1$  and  $\gamma_2$  capture the impact of deviations in unemployment from its natural rate on inflation and we theoretically expect that this coefficient to be negative, given the inflation-unemployment trade-off. Following Ball and Mankiw (2002), in our specification it is posited that expected inflation is equal to the last period's inflation.

The potential output is calculated by employing the Hodrick and Prescott (1997) filter that is widely used in the literature to decompose a time series into trend and cycle as well as the computation of potential output ( $Y^*$ ). The two-sided linear HP method estimates the potential output ( $Y^*$ ) from actual output  $Y$  by minimizing the variance of  $Y$  around  $Y^*$ . More specifically, the HP filter sets the potential component of output in order to minimize the following loss function:

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<sup>1</sup> In the sense of Gordon (1996), this proxy variable captures various exogenous shocks affecting aggregate price level.

$$L = \sum_{t=1}^T (Y_t - Y_t^*)^2 + \lambda \sum_{t=2}^{T-1} [(Y_{t+1}^* + Y_t^*) - (Y_t^* - Y_{t-1}^*)]^2 \quad (3)$$

where  $\lambda$  is the smoothing weight on potential output growth and  $T$  is the sample size.

Because of the use of annual time series data in this paper, it is assumed that  $\lambda=100$ . In an iterative process the HP filter sets the potential component of output or  $Y^*$  to minimise the loss function or  $L$  as shown in equation (3). It should be noted that as  $\lambda$  approaches zero, potential output would converge to actual output. Therefore, a lower smoothing factor ( $\lambda$ ) generates a ‘smaller’ estimate of the gap. One advantage of the HP filter is that it makes the output gap stationary using a wide range of smoothing values and it also allows the trend to vary through time.

### 3. Empirical Results and Policy Implications

Based on the Kalman filter recursive approach, the empirical results of applying the maximum likelihood estimation method to equations (1) and (2) are presented in Table II. The estimated coefficients of these two versions of the Phillips curve are seen to be of consistent sign and orders of magnitude and highly significant at the 1 per cent level. The resulting residual term from both models are stationary, all the estimated coefficients are statistically significant at least at the 1 per cent level and have the expected theoretical signs. With an adjusted  $R^2$  of 0.87-0.88, the estimated models also perform extremely well in terms of goodness-of-fit statistics and they pass each and every diagnostic test. The estimated coefficients reported in the second and fourth columns of Table II represent the short-run elasticities. One can divide them by one minus the lagged dependent variable coefficient (i.e.  $\alpha \approx 0.79$ ) to obtain the long-run elasticities.

As expected, changes in the import prices exert a positive impact on the rate of inflation, an important variable which has not been considered in previous studies. Therefore, *ceteris paribus*, a 10 per cent change in import prices would have led to a rise of



approximately 1.8 per cent in the rate of inflation. On the other hand, a one per cent fall in  $(U_{t-1} - U_{t-1}^*)$  would have resulted in about 7 per cent in inflation. This relatively high coefficient in both models suggests that if the actual unemployment rate is pushed below the NAIRU, a high inflation rate would be an unavoidable outcome. According to the results of Model II in Table II, the rising output gap could also positively influence the inflation rate.

**[Table II and Figure 2 about here]**

The estimated NARUs based on Model I and Model II are reported in Figure 2, which shows that the two measures are very similar in terms of their values and overall trend. According to Figure 2, it should be noted that during the last half a century whenever the unemployment rate has been below the NAIRU, the rate of inflation has substantially increased. For example see the NAIRUs, the unemployment rate and inflation in the period 1995-1996 and the post 2006 era in Figure 2. The estimated  $\gamma$  in both models is negative and statistically significant, suggesting that to some extent, there is a likelihood of trade-off between unemployment and inflation in the Iranian economy. It should be noted that there exists a vicious cycle in which a high inflation devalues the rial and a negligibly valued rial aggravates inflation. There are some empirical studies which have elucidated this cycle (e.g. Bahmani-Oskooee, 1993). The monetisation of the government budget deficit has played a major role in increasing money supply and hence inflation. Bahmani-Oskooee (1993, 1995) asserts that the Iranian authorities cannot curb rising prices without controlling the rising annual budget deficits and stabilising the value of the Iranian rial in the black market.

#### **4. Conclusion**

All previous studies have generated excessively high time-varying NAIRUs for Iran in the literature. In some studies the maximum value of the NAIRU was as high as 17 per cent. In this paper we have estimated two modified versions of the Phillips curve which is augmented by the output gap and import prices. Using the Kalman filter recursive approach, this paper

thus provides two maximum likelihood estimates for the time-varying NAIRU during the sample period (1959-2008). According to the results of Model I, the minimum and maximum values of the NAIRU were 4.4 per cent in 1962 and 11 per cent in 2008, respectively. The same corresponding figures for Model II were 5.1 per cent in 1963 and 11.1 per cent in 2008. Our results clearly indicate that in general once the unemployment rate rises, lowering it would entail a more pronounced rise in inflation (See Figure 2). Our estimated two measures of the NAIRUs are robust and consistent in terms of their magnitude and overall pattern, having a more plausible upper limit of 11.1 per cent in recent years. Consistent with Friedman's view, this paper also concludes that if the government attempts to drive unemployment down below the NAIRU, the result would be nothing except higher inflation. This phenomenon was witnessed in the Iranian economy particularly during 1995-1996 and the post 2006 era.

**Table I**

Previous time-varying estimates of Iran's NAIRU in the literature

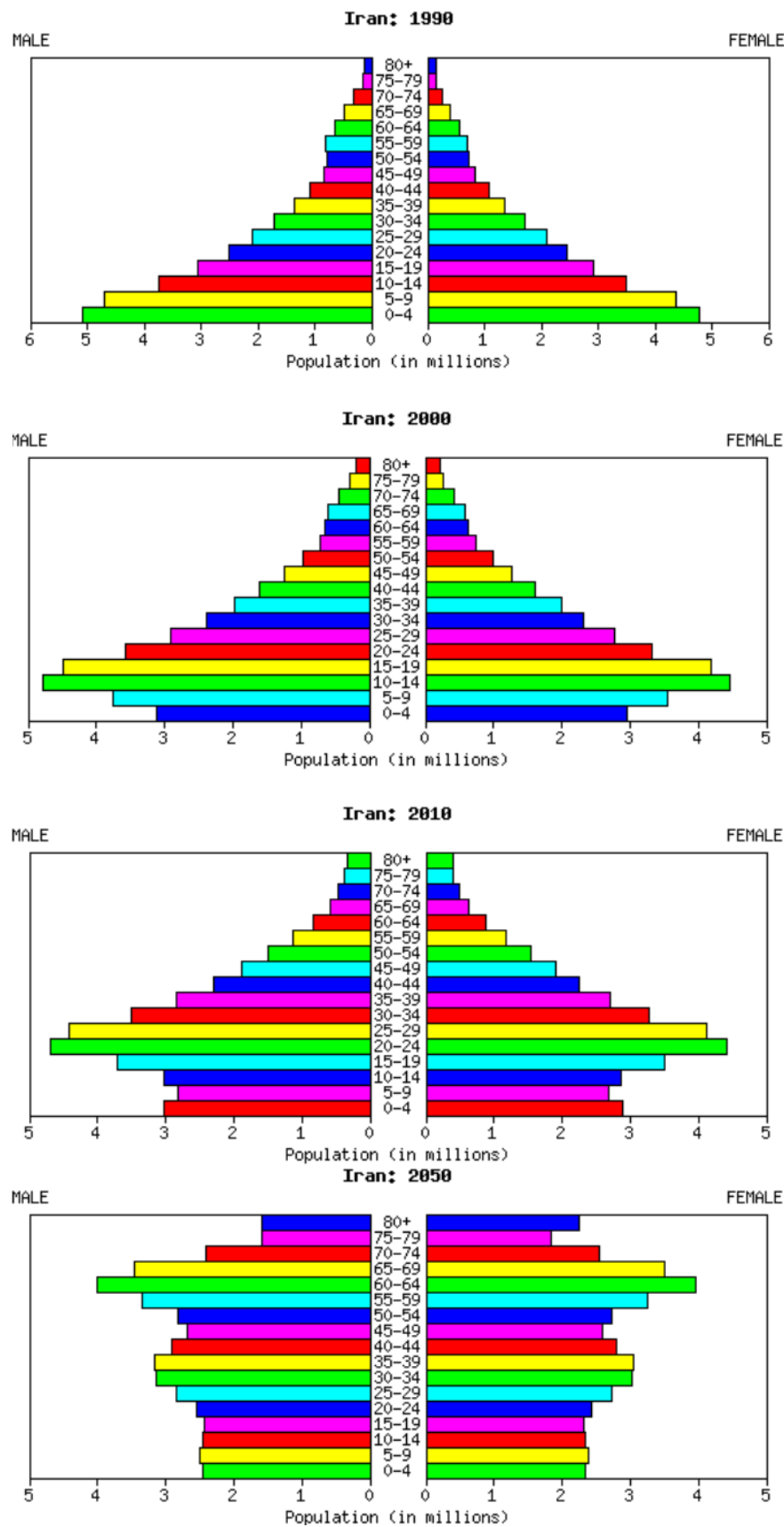
Sources	Samples	Estimation method	Min		Max		Average NAIRU
			% NAIRU	% Year	% NAIRU	% Year	
Mottaghi (1998)	1959-1996	Kalman Filter	3.5	1971	20.6	1995	8.6
Afshari and <i>et al.</i> (2009)	1961-2007 (annually)	VAR method	4.7	2000	17.4	1988	11.8
Barkchian and Sarem (2011)	1990-2009 (quarterly)	Ball and Mankiw (2002)	7	1997	16	1990	12
		Bayesian	5	1997	14	2002	11
Golmoradi and Dezhpasand (2011)	1964-2009 (annually)	SVAR method	2	1976	14.9	2000	9.5
This study	1962-2008 (annually)	Kalman Filter	4.4	1962	11	2008	9
			5.1	1963	11.1	2008	9.3

**Table II**Estimating the NAIRU using the Phillips curve and Kalman filter approach,  $\Delta \ln(P_t)$ 

Independent variables	Model I		Model II	
	Coefficient	P-value	Coefficient	P-value
$\Delta \ln(PM_t)$	0.183	0.00	0.182	0.00
$\Delta \ln(P_{t-1})$	0.788	0.00	0.787	0.00
$(Y_{t-1} - Y_{t-1}^*)$	-	-	0.001	0.00
$(U_{t-1} - U_{t-1}^*)$	-7.19	0.00	-7.10	0.00
$\bar{R}^2$	0.882	-	0.874	-
DW	2.01	-	2.01	-
Jarque-Bera $\chi^2$	0.726	0.695	0.512	0.774
Breusch-Godfrey Serial Correlation LM Test:	F(2,41)=0.692	0.51	F(2,39)=0.704	0.50
Heteroskedasticity Test: ARCH	F(1,44)=0.28	0.60	F(1,43)=0.35	0.56
Ramsey RESET Test:	F(1,42)=1.53	0.22	F(1,40)=1.65	0.21

**Source:** Authors' calculations.

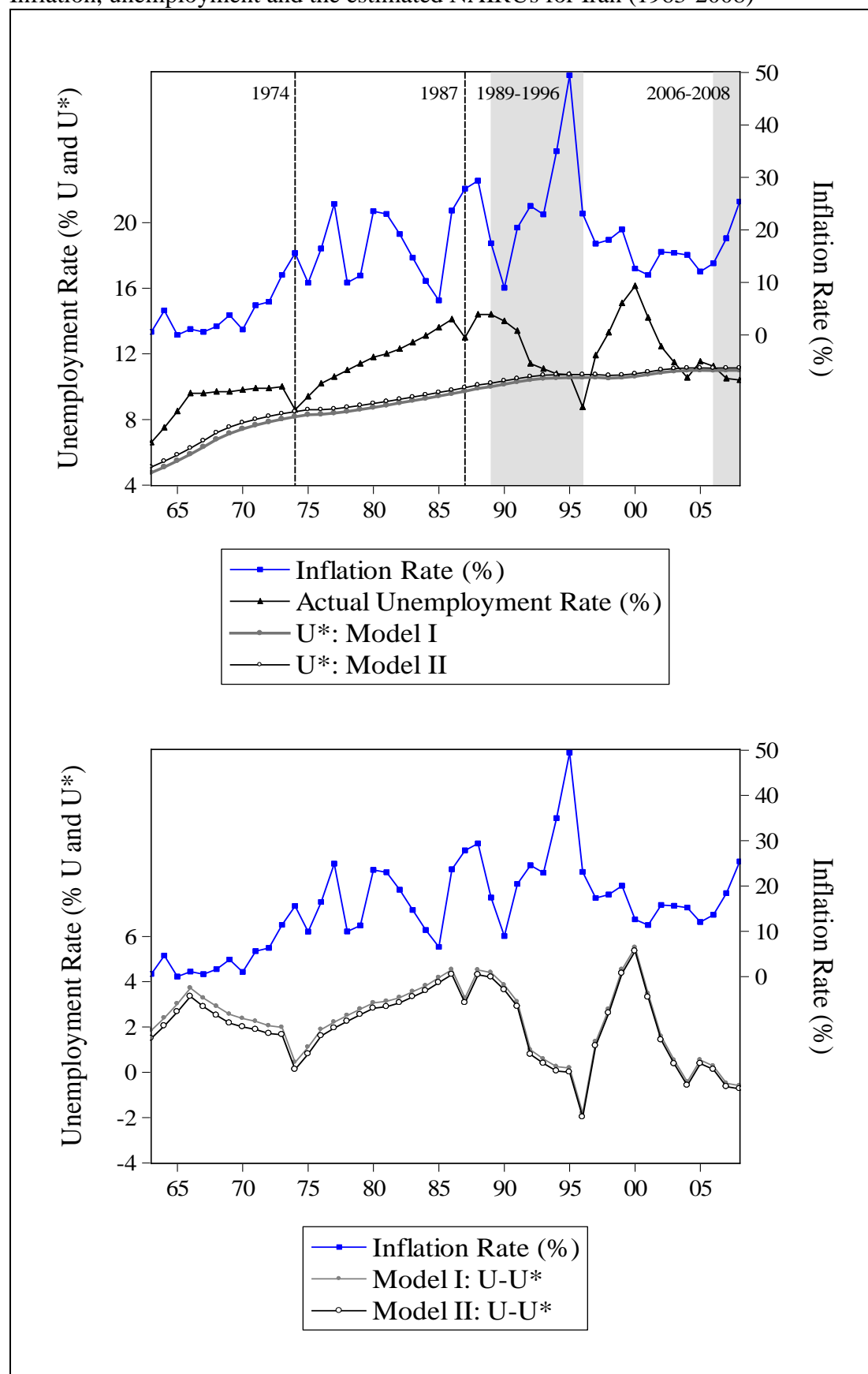
**Figure 1.**  
Iran's population pyramids (1990, 2000, 2010, 2050)



Source: <http://www.nationmaster.com>

**Figure 2.**

Inflation, unemployment and the estimated NAIRUs for Iran (1963-2008)



**Sources:** (1) The authors' calculations. (2) Valadkhani (1997, Appendix 1, pp.237-41). (3) Central Bank of Iran, *Economic Trends*, various issues, Tehran. (4) Economic Time Series Database of Iran's Central Bank at <http://tsd.cbi.ir/> (4) National Accounts database of Iran's Central Bank at <http://www.cbi.ir/simplelist/4454.asp>

## References

- Afshari, Z., Yazdanpanah, A. and Bayat, M. (2009), "NAIRU and economic policy in Iran", *Tahghighate Eghtesadi Journal*, Vol. 87, pp. 1-26.
- Bahmani-Oskooee, M. (1993), "Black market exchange rate *versus* official exchange rates in testing purchasing power parity: an examination of the Iranian rial", *Applied Economics*, Vol. 25, No. 4, pp. 465-72.
- Bahmani-Oskooee, M. (1995), "Source of inflation in post-revolutionary Iran", *International Economic Journal*, Vol. 9, No. 2, pp. 61-72.
- Ball, L. and Mankiw, N.G. (2002), "The NAIRU in theory and practice", *Journal of Economic Perspectives*, Vol. 16, pp. 115-36.
- Barkchian, M and Sarem, M (2011), "NAIRU estimation in Iran", *21<sup>st</sup> Annual Conference of Monetary and Exchange Policies*, 17-18 May, Tehran, Iran.
- Central Bank (2011), *Economic Indicators*, Department of Economic Accounts, Central Bank of Iran, Tehran < <http://www.cbi.ir/> >, Accessed August 2011.
- Golmoradi, H. and Dezhpasand, F. (2011), *Simultaneous measuring of the NAIRU and core inflation in the Iranian Economy*, Memo, Faculty of Economics, Shahid-Beheshti University, Tehran.
- Gordon, R.J. (1996), "The time-varying NAIRU and its implications for economic policy", *NBER Working Paper Series*, Working Paper No. 5735, Cambridge.
- Gruen, D. Pagan, A. and Thompson, C. (1999), "The Phillips curve in Australia", *Journal of Monetary Economics*, Vol. 44, pp. 223-58.
- Hodrick, R.J. and Prescott, E.C. (1997), "Postwar U.S. business cycles: an empirical investigation", *Journal of Money, Credit, and Banking*, Vol. 29, pp.1-16.
- Huh, H.S. (2006), "A forecast based NAIRU measure of the US", *Applied Economics Letters*, Vol. 13, pp. 177-82.
- Katsouli, E. and Pallis, D. (2003), "Estimating the NAIRU in the 15 European Union member-countries", *Review of Economic Sciences*, Vol. 3, pp. 53-66.
- Mottaghi, L. (1998), *The Trade-off Between Output and Inflation in Iran and Testing the Natural Rate of Unemployment and NAIRU in Iran*, An unpublished Ph.D. thesis submitted to The University of Tehran, Tehran.
- Salehi-Esfahani, H. and Shajari, P. (2010), *Gender, Education, Family Structure, and the Allocation of Labor in Iran*, Memo, University of Illinois.
- Stanley, T.D. (2002), "When all are NAIRU: hysteresis and behavioural inertia", *Applied Economics Letters*, Vol. 9, pp. 753-57
- Staiger, D., Stock, J.H. and Watson, M.W. (1997), "The NAIRU, unemployment and Monetary policy", *Journal of Economic Perspectives*, Vol. 11, No. 1, pp. 33-49.

Valadkhani, A. (1997), *A Macroeconometric Model for the Iranian Economy*, An unpublished Ph.D. thesis submitted to The University of Queensland, Brisbane.

Valadkhani, A. (2003), “The causes of unemployment in Iran”, *International Journal of Applied Business and Economic Research*, Vol. 1, No. 1, pp. 21-33.